URBAN RUNOFF

Urban areas are characterized by many miles of roads, acres of parking lots, residences, businesses, and industries. Very little precipitation reaches the soil; most quickly runs off into nearby waterways. The effects of this stormwater on the environment include:

- degraded water quality due to erosion, sedimentation, and urban contaminants
- damage to or destruction of wetlands
- increased flooding
- reduction and degradation of groundwater (U.S. Environmental Protection Agency, 1990)

This stormwater runoff is also the largest source of nonpoint source pollution in urban areas. Along the way it picks up virtually anything on the ground or dumped into the gutters such as:

- car wash detergents
- trash
- dead animals and animal waste
- paint
- oil, gasoline, and other automotive fluids
- fertilizers and pesticides
- road salt and deicing chemicals
- soil
- grass and leaf litter

In some communities the runoff flows down the street gutters to storm drains that empty into underground storm sewage systems. However, few communities can afford to treat stormwater runoff, so most storm sewers empty directly into nearby waterways or, in some areas of Kentucky, sinkholes, which funnel it directly to the groundwater.

Chemical pollutants such as paint, paint removers, deicing chemicals, insect sprays, automotive fluids, etc., that are dumped down storm drains may get diluted but are not biodegradable. If these pollutants reach the groundwater, it may take decades before the water is useable again. For example, four quarts of used oil will contaminate a million gallons of surface or ground water (Murphy, Heaton, and Henkon)!

The amount and velocity of runoff in urban areas can be minimized by:

- using permeable paving surfaces to increase absorption
- landscaping with native trees and plants to increase absorption
- retaining runoff in catch basins
- grading to create gentle slopes to reduce the velocity of runoff

(New Jersey Department of Environmental Protection, 1987; Wisconsin Department of Natural Resources, 1989).

The pollution carried by the runoff could be reduced by:

- putting trash in trash cans, not throwing it on the ground
- using correct amounts of pesticides and fertilizers
- keeping lawn care chemicals off sidewalks and out of gutters
- picking up animal waste

- disposing of old paint and other household chemical waste in licensed hazardous waste landfills
- fixing automotive leaks
- recycling used oil
- using sand and gravel for deicing roads
- not dumping anything down storm drains or sinkholes

The following activities illustrate how urban runoff affects water quality.

See also THE EARTH'S SPONGE activity, p. 16 of this manual.

JILL AND FRED'S EXCELLENT ADVENTURE

GRADES: 4-8*
SUBJECT: Geography, Language Arts
SKILLS: Analyzing, applying, discussing, listening, observing, problem solving, writing
DURATION: 2 hours
SETTING: Indoors
KERA ACADEMIC EXPECTATIONS: 1.3, 1.4, 1.11, 2.3, 2.19, 3.6, 3.7, 5.1, 6.1, 6.3

OBJECTIVE:
To gain an understanding of how polluted water travels throughout a community.

METHOD:
Supply ending to pollution story by following the community's storm sewer system.

MATERIALS NEEDED PER PARTICIPANT:

- Worksheet - Jill and Fred's Excellent Adventure
- Pencil
- Paper
- Topographic or road map of community

PROCEDURE:

- Walk though a selected area noting drainage patterns and location of storm drains.
- Read the story on Worksheet - Jill and Fred's Excellent Adventure.
- Finish the story using information noted on the walk.
- Use the maps for reference.

EVALUATION:

- Where did the storm drains lead to?
- Did they lead to the same place?
- How many watersheds were involved?

EXTENSIONS:
Make a drawing showing the path of the storm drains or drainage paths.

* For Grades K-3 complete the activity as a group using the storm drains or drainage paths on school grounds.
For Grades 9-A complete the activity without reading story.

(adapted from Ecology Center)

WORKSHEET - JILL AND FRED'S EXCELLENT ADVENTURE

Jill and her friend Fred were sitting around on a Saturday morning when they saw a man changing the oil in his car. A minute later, they noticed he was dumping the oil down the storm drain and into the sewer.

"Hey, Fred! That could pollute the storm sewer!" Jill said. "Where do you think that sewer goes?"

"I don't know, but let's find out," said Fred.

Jill and Fred started to trace the storm sewer. They found.....

OTHER RESOURCES

GRADES:

K-3 Hirschland, Roger B., ed., 1992, Lesson 1- Down the Drain: National Geographic Society, Teacher's Handbook, Geography, Reflections on Water, p. 13.
How urban runoff pollution gets to waterways.

1-8 The Watercourse and Council for Environmental Education, 1995, Amaze-ing Water: Project WET, pp. 219-222.
How actions in the home and yard affect water quality.

2-6 American Forest Foundation, 1994, Pollution Search: Project Learning Tree, Pre K-8 Activity Guide, p. 114-118.
Search for sources of water pollution within community.

4-8 The Watercourse and Council for Environmental Education, 1995, Rainy-Day Hike: Project WET, pp. 186-190.
Identify watershed on school grounds and collect data about water flowing over school grounds

4-A Western Regional Environmental Education Council, 1987, Watershed: AQUATIC Project WILD, pp. 163-167.
Measure area of watershed, calculate amount rainfall it receives each year, and discuss relationship of watershed to human and wildlife habitats.

6-A Western Regional Environmental Education Council, 1987, Where Does Water Go After School?: AQUATIC Project WILD, pp. 75-77.
Calculate amount of precipitation falling onto schoolgrounds and trace path of water to nearest body of water.

9-A The Watercourse and Council for Environmental Education, 1995, Color Me a Watershed: Project WET, pp. 223-231.
Observe how development can affect a watershed.

PROBLEM SOLVING

Resolving the conflicts that arise between development and water quality protection are problems that communities are facing more often. Within the watershed, land is being used for residences, businesses, industry, and farming, with very little left untouched. Each of these uses contributes to non-point source pollution, and if the watershed is polluted, then the water will be polluted.

Water quality protection in a community starts with land-use planning including the use of best management practices designed to reduce or eliminate non-point source pollution.

The following activities deal with real-life situations associated with land use vs. water quality protection. Use Worksheet - Best Management Practices for Nonpoint Source Pollution, as a reference (see Appendix A).

SECRET SINK

GRADES: 6-A
SUBJECT: Geography, Science, Economics, Social Studies
SKILLS: Analyzing, applying, classifying, communication, comparing, describing, discussing, drawing, evaluating, inferring, interpreting, inventing, listening, listing, mapping, problem solving, role playing, small group work, speaking, visualizing
DURATION: 2-3 class periods
SETTING: Indoors
KERA ACADEMIC EXPECTATIONS: 1.2, 1.4, 1.7, 1.12, 2.1, 2.2, 2.14, 2.18, 2.19, 3.6, 4.2, 4.4, 4.6, 5.1, 5.2, 5.4, 5.5, 6.1, 6.2

OBJECTIVE:
To gain an understanding of the relationship between land development and water quality protection.

METHOD:
Develop a community land-use plan in a karst region.

MATERIALS NEEDED PER GROUP:

- Large sheet of paper (18" x 24")
- Crayons, colored pencils, etc.
- Scissors
- Masking tape
- Glue
- Worksheet - Secret Sink Community cutout
- Worksheet - Secret Sink Community Map

PROCEDURE:

- Divide class into several groups, each one representing an interest group such as:
  Residents - to live in the area
  Farmers - to use the land for crops and livestock
  Industry - to use the land for economic growth and trade
  Small businesses - to provide local services
  Park managers - to preserve and protect the natural resources
  Solid Waste Dept. - to dispose of community's garbage
  "Save Our Sinks" environmental group - to protect the sinkhole
  Others???
- Have each group brainstorm about how each land use impacts water quality. Discuss the results as a class and make a list PRO and CON for each land use.
- Pass out the materials needed and cut out the community pieces. Glue the map to the center of the large paper and extend the river to the edges.
- Each group will be responsible for the development of a community land use plan in the Secret Sink region with emphasis on:
  the priorities of the group's special interest
  not excluding any land use
  using all community buildings
  preservation and protection of natural areas
  water quality protection
  everyone must agree - compromise!

- Arrange the cutouts on the map as plans are being made. Use loops of tape to temporarily stick pieces to map. Glue when final plan has been made.
- When plans are final, hold a Town Meeting, with each group sharing its plan. Discuss similarities, differences, and consequences of some actions on water quality.
- Display each group's plans and from them develop a comprehensive land-use plan for the Secret Sink community.
- Set up the new community plan on a larger map.

EVALUATION:
This activity demonstrates the concerns facing communities that are planning for development while trying to protect water quality.

- Did everyone agree to the new plan?
- What were the issues that caused the most problems?
- What interest group compromised the most? Why?
- What are the environmental consequences of the final plan?
- What can be done to minimize these consequences?

EXTENSIONS:
Develop a watershed plan:

- Divide class into several groups, each group member representing a different interest group.
- Have each group develop their own community plan.
- Create a watershed by aligning the maps so that the rivers flow as one large river.
- What is the impact of one community's plan on the communities downstream from it?
- What could be done to minimize these impacts?
- Create a land-use plan for the watershed. What are some problems in getting communities to work together? (political jurisdictions, politics, ideologies, funding, etc.)
- How could some of these problems be overcome?

Use the local community for this activity.

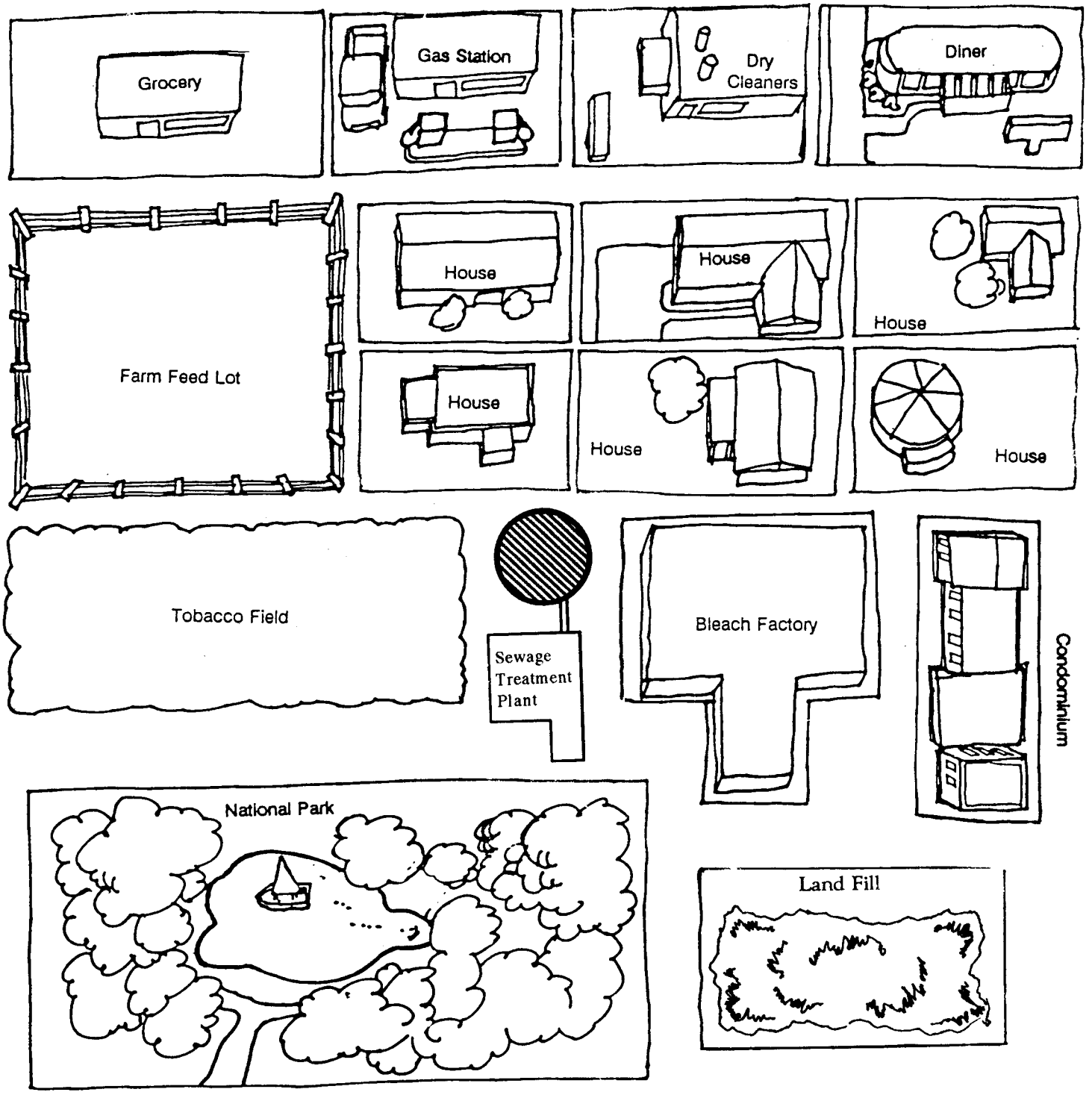
- Is a land-use development plan in use?
- Does the plan address water quality protection?
- What are the environmental consequences of the plan?
- What can be done to minimize these consequences?

Create a community with a coal strip mine as the environmental focus.

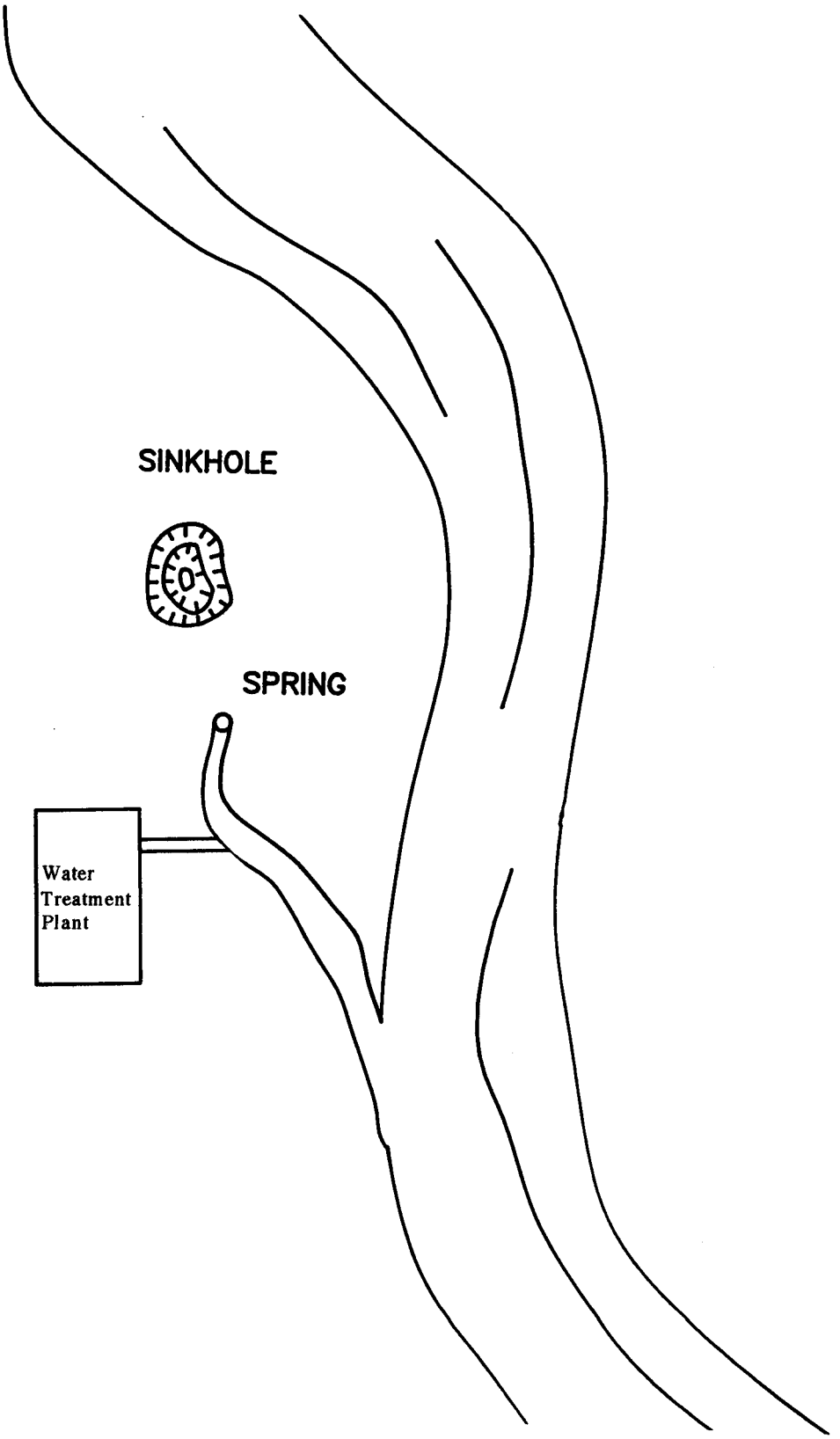
- What are some water quality concerns related to mining?

(adapted from American Cave Conservation Association, Inc., 1994; Western Regional Environmental Education Council, 1987)

WORKSHEET - SECRET SINK COMMUNITY CUTOUTS



WORKSHEET - SECRET SINK COMMUNITY MAP



TO DEVELOP OR NOT TO DEVELOP?

GRADES: 6-A
SUBJECT: Economics, English, Social Studies
SKILLS: Analyzing, applying, communicating, debating, decision-making, discussing, evaluating, interviewing, listening, problem-solving, reporting, research, writing
DURATION: 2-3 class periods
SETTING: Indoors
KERA ACADEMIC EXPECTATIONS: 1.1, 1.2, 1.4, 1.11, 2.18, 3.6, 4.1, 4.4, 4.6, 5.3, 5.4, 5.5, 6.1, 6.3

OBJECTIVE:
To evaluate the impacts of local development projects and weigh their positive and negative aspects.

METHOD:
Discuss local development projects and select one for an in-depth study.

MATERIALS NEEDED:

- Local newspapers

PROCEDURE:

- For several months collect newspaper clippings of development projects along a river or stream that affect the community.
- Discuss these projects:
  What are the benefits of this project?
  Who benefits from it?
  What are the costs or negative aspects of this project?
  Who is affected by these negative aspects?
  Do the benefits outweigh the costs?
- Select one of the projects for in-depth study.
- Discuss in detail the issues mentioned previously.
- Prepare in-depth questions and invite a spokesperson from the development project to present their views.
- Try to come to a consensus as a class on the support or opposition of the development activity. Respect everyone's opinions.

EXTENSIONS:

- Write editorials explaining the project and expressing the different viewpoints.
- Hold a classroom debate on the issues.

(Adapted from U.S. Environmental Protection Agency, 1991)

OTHER RESOURCES

GRADES:

2-6 The Joint Council on Economic Education, 1989, Who wants to Pay?: Elementary Economist: vol. 10, no. 3.
Gain an appreciation of the costs of pollution abatement and the complexity of the problem of who should clean it up by conducting a simulation of manufacturers and consumers.

2-8 Western Regional Environmental Education Council, 1987, Something's Fishy Here!: AQUATIC Project WILD, pp. 169-173.
Invent ending to story that could be projected to environmental action in local community.

3-8 Water Resources Education Initiative, 1996, Wise Wetlands Ways: U.S. Geological Survey, Poster Series, Wetlands - Water, Wildlife, Plants and People.
Describe how wetlands benefit people and what actions can be taken to protect wetlands.

3-A Western Regional Environmental Education Council, 1987, Deadly Waters: AQUATIC Project WILD, pp. 137-141.
Analyze and graph pollutants found in hypothetical stream, recommend best management practices.

4-8 Kashanski, Catherine, Role Playing Game: Vermont Agency of Natural Resources, Water Quality Division, National Wildlife Federation National Wildlife Week, Wading into Wetlands, Poster.
Role-playing with conflicting interests at public hearing on new development that may have impact on wetlands
The Watercourse and Council for Environmental Education, 1995, Humpty Dumpty: Project WET, pp. 316-321.
Relate challenges of environmental restoration to jigsaw puzzle.

4-A Western Regional Environmental Education Council, 1987, Dragonfly Pond: AQUATIC Project WILD, pp. 143-148.
Create collage of land use activities around a pond.
Environmental Concern and The Watercourse, 1995, Hydropoly: WOW! The Wonders of Wetlands, pp. 260-265.
A game of wetlands management.

5-A Environmental Concern and The Watercourse, 1995, Hear Ye! Hear Ye!: WOW! The Wonders of Wetlands, pp. 252-265.
Conduct a mock public hearing to make a group decision on an important project that affects a wetland.

6-A The Watercourse and Council for Environmental Education, 1995, Dilemma Derby: Project WET, pp. 377-381.
Debate pros and cons of different solutions to water management issues.
_____, Perspectives: Project WET, pp. 397-399.
Analyze public values toward water issues.

7-8 American Forest Foundation, 1994, Watch on Wetlands: Project Learning Tree, Pre K-8 Activity Guide, pp. 258-264.
Analysis and protection of a wetland.

U.S. Department of Agriculture, and U.S. Forest Service, Rocky Mountain Region 1995, 400 Acre Wood: Ecosystem Matters, Activity and Resource Guide for Environmental Educators, pp. 171-177.
Create management plan for hypothetical piece of public forest land.

7-A The Joint Council on Economic Education, 1989, Pollution Detectives: Elementary Economist: vol. 10, no. 3.
Investigate pollution problems in community, learn about laws that affect these problems, and make decisions that involve weighing the costs and benefits of pollution cleanup.

9-A Environmental Concern and The Watercourse, 1995, Wetlands Tradeoffs: WOW! The Wonders of Wetlands, pp. 285-287.
Inventory wetlands benefits and debate tradeoffs in wetlands issue.

The Watercourse and Council for Environmental Education, 1995, Water Court: Project WET, pp. 413-420.
Solve water conflicts through mediation and litigation.

U.S. Department of Agriculture, and U.S. Forest Service, Rocky Mountain Region 1995, Mayhem in the Maldives: Ecosystem Matters, Activity and Resource Guide for Environmental Educators, pp. 197-210.
Use role-playing to solve problems that arise when trying to make water-use decisions on an island.